6-1-1992

UA3/8/1 John Robinson Professorship Report

WKU Ogden College of Science & Technology

JOHN ROBINSON PROFESSORSHIP

Summary of
November 1, 1987 - June 1, 1992 Report
John T. Riley

Some highlights of the Robinson Professorship report submitted on May 29, 1992 to Dr. Charles Kupchella covering the November 1, 1987 - June 1, 1992 period include the following:

- Total funds provided by interest income from the Robinson Professorship over the five-year period was $25,800.
- 22 undergraduate students were involved in research.
- 15 research projects were supported by funds from the Robinson Professorship income.
- 51 papers were presented by J.T. Riley and students at local, regional, national, and international scientific meetings.
- 24 publications resulted from research project coauthored by John T. Riley and students.
- Grants totalling $245,920 were obtained using Robinson Professorship funds as matching funds.
- More than $28,888 in free service work was provided to faculty and students in Ogden College in support of various research projects.
- Support was provided for two visiting professors from the People's Republic of China and one from South Africa.
- Analytical data was provided for two federal agencies [National Institute for Standards and Technology (NIST - formerly NBS) and American Society for Testing and Materials (ASTM)] and an international agency [International Standards Organization (ISO)] for evaluating standards and certifying standard reference materials.
- Fifteen students supported by funds from the Robinson Professorship earned their bachelors' degrees and entered professional schools or began careers as productive scientists.

Additional notes about achievements by J.T. Riley and students in connection with funds provided by the Robinson Professorship are as follows:

- The total funds earned and used for part-time salaries for J.T. Riley's workers during the 1987-1992 period was $123,521. This total includes the funds from the Robinson Professorship income, grants, and the Coal and Fuel Laboratory income. The funds from the Robinson Professorship has enhanced the activities in the Coal and Fuel Laboratory over the last five years.
- This semester four new students have been hired to work on various research and public service projects.
- Four papers have been published and one paper has been submitted for publication since June, 1992.
- An equipment grant with $39,810 was obtained from the LECO Corporation on September 1, 1992.

JOHN ROBINSON PROFESSORSHIP

November 1, 1987 - June 1, 1992 Report
John T. Riley

The selection criteria used for awarding the John Robinson Professorship were the recipient's

- record and potential as an educator
- record of, and potential for, involving students in research
- record of, and potential for, research and scholarly achievement
- record of, and potential for, professional service.

The information presented in this five-year report will address each of these criteria, especially citing results and accomplishments that indicate growth in each of the four areas.

I. Record and Potential as an Educator

A chemistry professor that is recognized as an educator is one that prepares his/her students to assume professional roles as competent and productive scientists. Chemistry is a laboratory science which can best be learned in laboratory situations. I prefer to teach laboratory courses. Consequently, the majority of the courses I teach are laboratory courses, or have a laboratory component. The list of chemistry courses I have taught over the last five years are as follows:

- CHEM 223, College Chemistry II Laboratory
- CHEM 301, Consumer Chemistry
- CHEM 307, Coal Chemistry Laboratory
- CHEM 435, Instrumental Analysis
- CHEM 531, Advanced Analytical Chemistry
- CHEM 591, Coal Chemistry Laboratory (Graduate)

The department heads' evaluations of my teaching performance in relation to the other 15-16 members of the Chemistry Faculty over the last five years are given in Table 1. Also summarized in the table are my faculty workload assignments for the 1987-91 period.

II. Record of, and Potential for, Involving Students in Research

Part of a chemistry major's education must include research experience. Thanks to the availability of funds from the Robinson Professorship, I have been able to attract a large number of young scientists to work on various research projects. Table 2 summarizes the involvement of 22 students in research projects I have directed over the last five years.

Table 1

Teaching Evaluations and Workload Assignments

	Outstanding	Good	Satis-factory	Needs Improvement	Unsatis-factory	Average Workload[A] over 2 Semesters
1987	X					50%T, 25%A, 25%R[B]
1988	X					50%T, 25%A, 25%R
1989		VG	(VG means very good)			50%T, 25%A, 25%R
1990		VG				58%T, 25%A, 25%R[C]
1991		VG+				75%T, 25%A

[A] T = Teaching assignment; A = Administrative assignment (Director of the Center for Coal Science); and R = Research assignment.

[B] The research assignment included 12.5% (average for the year) for USDOE-sponsored research.

[C] The research assignment was 25% for the year for research sponsored by the IL Coal Board.

III. Record of, and Potential for, Research and Scholarly Achievement

The success of research projects can be measured by the quality and quantity of research papers presented at professional meetings and published in scientific journals and proceedings. A total of 51 papers were presented at scientific meetings by John T. Riley and/or his students during the 1988-92 period. A list of these papers is given in Appendix A. A total of 24 publications resulting from research projects were coauthored by John T. Riley and his students during the same time period. A list of these publications is given in Appendix B. These papers and publications resulted from research projects supported by funds from the Robinson Professorship.

Portions of the interest income from the Robinson Professorship have been used as matching funds to help secure research grants from funding agencies and instrumentation grants from equipment manufacturers. Table 3 lists the research grants and equipment acquisitions that were made possible using professorship funds. The total value of these grants is $245,920 and represents about half the grants received by John T. Riley during the 1987-92 period. Three other equipment grants, with Dr. Wei-Ping Pan as the project director, were secured using Robinson Professorship interest income as promissary funds to insure that student researchers would be available to use and evaluate the instrumentation obtained in the grant. Fortunately, projects were generated by Dr. Pan that were used in the instrumentation evaluation process.

Table 2

Undergraduate Students Involved in Research Projects
Supported by the Robinson Professorship

Dates	Undergraduate Students	Major and Hometown	Projects
1987-89	Mark Risen	Biology; Greensburg, KY	1&7
1988-89	Robert Forsythe	Chemistry; Leitchfield, KY	2,4&7
1988-89	Edward Farrar	Computer Science; Williamsburg, KY	3
1988	Todd Link	Psychology & Chem.; Louisville, KY	5
1988-89	Alisha Keltner	Medical Technology; Greensburg, KY	4
1988	Dan Withers	Mech. Engin. Tech., Louisville, KY	2
1988	Chris Howlett	Chemistry; Cadiz, KY	2
1988	Anna J. Morgan	Chemistry; Scottsville, KY	5
1988-90	Rich Tibbits	Geology & Chemistry; Dayton, OH	2,7,8&10
1988-90	Scott Gilleland	Chemistry; Bowling Green, KY	2,7,8&9
1988-92	Harold D. Graham	Chemistry; Brownsville, KY	2,8,10&14
1989	Greg LaRoy	Chemistry; Covington, KY	4
1989-90	Suzanne Wilson	Biochemistry; Evansville, IN	8
1990-91	Scott Coffey	Chemistry; Russell Springs, KY	4,8&14
1989-90	Sarah Sadler	Pre-Pharmacy; Bowling Green, KY	8
1989-92	Mike Mertens	Biology & Chemistry; Hermitage, TN	8,9&14
1989-92	Joe Werth	Biology & Chem.; Russellville, KY	8,9,13&14
1991-92	Stuart Burris	Chemistry; Campbellsville, KY	11,12&15
1990-91	Melissah Hite	Biology; Elizabethtown, KY	8&14
1990-92	Michelle Lewis	Biochemistry; Bowling Green, KY	8,9,13&14
1991	Trent Selby	Chemistry; Russell Springs, KY	13&14
1991-92	Jeff Stidam	Biology; Scottsburg, IN	13&14

No.	Project Description
1.	Development of x-ray fluorescence (XRF) spectrometric method for ashed materials
2.	A study of the nonadditive analytical values for coal blends
3.	Development of computer programs for the Coal & Fuel Characterization Laboratory
4.	Sulfur distributions in coal extract residues
5.	Coal desulfurization studies
6.	Sulfate analysis using high performance liquid chromatography (HPLC)
7.	Development of a method to predict coal ash fusion temperatures from elemental composition
8.	Removal of aliphatic sulfur and chlorine compounds from coal
9.	Inductively coupled plasma-atomic emission spectrometric (ICP) analysis of coal slurries
10.	X-ray flourescence (XRF) analysis of raw coals
11.	Preparation and evaluation of combination fuels for fluidized bed combustor (FBC) systems
12.	Rapid measurement of moisture and total hydrogen in coal
13.	Determination of major, minor and trace elements in new and used horse feed
14.	Microbial desulfurization of coal
15.	Speciation of sulfur forms in coal

Table 3

Research Grants and Equipment Acquisitions Secured by Matching Funds from the Robinson Professorship

Year	Grant Description	Agency or Company	Amount of Grant
1989	Acquisition of an Inductively Coupled Plasma Spectrometer (ICP)	LECO Corp.	$67,500
1990	Removal of Aliphatic Sulfur and Chlorine Compouds from Coal	IL Coal Dev. Board.	25,707
1990	Acquisition of Sulfur Analyzer	LECO Corp.	29,070
1990	Rapid Measurement of Moisture and Total Hydrogen in Coal	LECO Corp.	44,675
1991	Combination Fuels for Fluidized Bed Combustor Systems	KY Div. of Energy & TVA	19,330
1991	Upgrade of Carbon, Hydrogen, and Nitrogen Analyzer in the WKU Coal & Fuel Characterization Laboratory	LECO Corp.	30,000
1992	Co-Firing Biomass Fuels with Coal	TVA	29,638
		Total Value of Grants =	$245,920

The arrangements normally made for the instrumentation grants is to offer the equipment manufacturer a thorough evaluation of a new instrument in return for the placement of the instrument at Western. The evaluations are done by several students running multiple analyses on a large number of samples to collect precision and accuracy data according to an American Society for Testing and Materials (ASTM) standard protocol. Other evaluations, such as use of the instruments in research projects or on a large variety of samples submitted by numerous faculty and student researchers are performed. Formal reports on the performance of the instruments, in comparison to other methods of analysis, are then written. Emphasis on the input from students regarding ease of operation, maintenance requirements, repeatability and reproducibility, etc., are highlighted in the reports.

In the research project grants from the IL Coal Board, the Kentucky Division of Energy, and TVA, matching funds from the Robinson Professorship interest income were used for undergraduate student salaries in order to obtain additional funds for student salaries, supplies, travel funds, overhead costs, etc. Most grant agencies require some matching and the professorship income is a convenient source of matching funds.

IV. Record of, and Potential for, Professional Service

The public service activities supported by income from the Robinson Professorship were quite varied and included projects ranging from help with high school science fair experiments to contributing data for certifying standard reference materials. Summaries of some of these public service activities are given in Table 4. The value of the free service work was determined using the cost schedule the Coal and Fuel Characterization Laboratory has established for grants and contract work. Generally, the analytical services provided by the undergraduate workers to the faculty and students involved the elemental analysis of a large variety of samples. Elements determined included carbon, hydrogen, nitrogen, sulfur, chlorine, and over 30 other elements by various spectroscopic techniques. Samples included feed supplements, plants, synthesis and reaction products, catalysts, a wide variety of polymers, waste water, woods, animal wastes, blood, and all types of fuels.

In addition to the analysis of the various samples, the undergraduate student workers also demonstrated the use of the instrumentation in the Coal and Fuel Characterization Laboratory to several groups of campus visitors each year, as well as to several laboratory classes in Engineering Technology, Biology, Geology, and Chemistry.

Another use of the interest income from the Robinson Professorship was to help support foreign scholars visiting the Center for Coal Science by providing some of their living expenses during their stay. Three scientists that have been supported in this manner are Shiyong Zhou, Dr. James Willis, and Dexiang Zhang. Professor Zhou is a coal scientist from the Anshan Institute of Iron and Steel Technology, People's Republic of China (PROC) who conducted research at WKU for six months in 1988-89. Dr. James Willis is a geochemist from the University of Cape Town, Rondebosch, South Africa, who spent two weeks at WKU in 1990. Mr. Dexiang Zhang is a coal scientist from the Huainan Mining Institute, PROC, who will spend six months at WKU in 1992. The coal science faculty and students have benefited from having these three scientists working with them.

V. Summary

One way to assess the benefits derived from having the use of the interest income from the Robinson Professorship over the last 4.5 years is to compare the interest income used to the funds generated from grants and the free service work provided to WKU faculty and students. Table 5 lists the interest income used. The total of $25,800 is much less than the $245,920 from grants (Table 3) and the $28,888 (Table 4) worth of free service work provided.

Another way to assess the benefits derived from the use of the interest income from the Robinson Professorship is to note the 51 oral presentations and 24 publications resulting from research supported by the professorship. Especially worth noting is the number of student coauthored papers and publications.

Table 4

Summaries of Some Public Service Activities Supported by Robinson Professorship Interest Income

A. Free Analytical Services Provided to WKU Faculty and Students

Years	1987-88	1988-89	1989-90	1990-91	1991-92
Number of WKU Professors Receiving Services		5	3	7	8
Value of Services	records incomplete	$1,754	$3,083	$12,300	$11,751

Total value of services = $28,888

B. Public Service Provided to Federal Agencies and Professional Societies

Analysis of coal sulfur forms in seven standards for the National Institute for Science and Technology (NIST -- formerly NBS). The data is to be used in the certification of the standards.

Analysis of samples for the Ash Fusion Technical Committee of the International Standards Organization (ISO) in an international round robin used in developing a standard method.

Preparation, distribution, and analysis of 10 samples for the Instrumental C, H, & N Task Group of the American Society for Testing and Materials (ASTM). The Task Group is developing a standard method for instrumental C, H, & N analysis in coal and coke.

Participation in and analysis of round robin samples of coal and coke in the development of three ASTM standard methods: D-5142 for the instrumental analysis of the moisture, ash, and volatile matter in coal and coke; D-5016 for the analysis of sulfur in coal and coke ash; and D-4326 for the analysis of major and minor elements in coal and coke ash by x-ray fluorescence spectroscopy.

Table 5

Interest Income from the Robinson Professorship

Years	1987-88	1988-89	1989-90	1990-91	1991-92
Interest income used	$5,000	$5,600	$5,200	$5,500	$4,500

Total interest income used = $25,800

Yet another way to assess the benefits derived from the Robinson Professorship is to note the number of students involved in professional scientific activities while they are still in school. The research and analytical chemistry experience gained in working on the various research and service work projects will always be with them. These young people leave Western with a lot of confidence and are much better prepared for the challenges of a professional position, graduate school, or professional school. Table 8 lists the students from Table 2 that have graduated from Western and where they went after graduation. I believe these young people are all on their way to becoming productive scientists who will always have fond memories of their undergraduate experiences at Western.

Table 8

Students Involved in Research Projects Supported by the Robinson Professorship That Have Graduated from WKU

Students	Major, Degree, Date	Position After Leaving WKU
Mark Risen	Biology, B.S., 1988	Medical School in Iowa
Robert Forsythe	Chemistry, B.S., 1990	Teaching Chemistry at Warren East High School, BG, KY
Edward Farrar	Computer Sci., 1991,	Harris Corp., Melborne, FL
Todd Link	Psych. & Chem., B.S., 1989	Working in family landscaping business, Louisville, KY
Alisha Keltner	Medical Technology	Married Mark Risen, left WKU
Dan Withers	Mech. Engn. T., B.S., 1988	Coal Chemist, Green Coal Co., Owensboro, KY
Anna J. Morgan	Chemistry, B.S., 1988	Chemist, Logan Aluminum, Inc., Russellville, KY
Rich Tibbits	Geol. & Chem., B.S., 1990	Geologist, QSource Environmental Serv., Dayton, OH
Harold D. Graham	Chemistry; B.S., 1992	Graduate School, University of North Carolina
Greg LaRoy	Chemistry; B.S., 1989	Graduate School, Miami University, OH
Suzanne Wilson	Biochemistry, B.S., 1990	Medical School, Indiana Univesity
Scott Coffey	Chemistry, B.S., 1992	Graduate School, Indiana University, Bloomington, IN
Sarah Sadler	Pre-Pharmacy, 1990	Pharmacy School, Mercer University, Atlanta
Mike Mertens	Biol. & Chem., B.S., 1992	Medical School, Unversity of Tennessee
Melissah Hite	Biology, B.S., 1991	Working in Corpus Christi, TX
Trent Selby	Chemistry, B.S., 1992	Graduate School, Virginia Polytechnic University, Blacksburg, VA

APPENDICES

Appendix A

Papers Presented During the 1988-92 Period by J.T. Riley and Students at Local, Regional, National and International Scientific Meetings (The Name of the Presenter is Underlined)

M. Risen and J.T. Riley, "Elemental analysis of Ashed Materials by X-Ray Fluorescence Spectroscopy," 18th Annual Sigma Xi Research Conf., WKU, Mar. 24, 1988.

F.J. Hayes, D.L. Withers, and J.T. Riley, "Measured Versus Calculated Analytical Values for Coal Blends," 18th Annual Sigma Xi Research Conf., WKU, Mar. 24, 1988.

J.T. Riley, "Coal and Sulfur Forms Analysis and Desulfurization," Internat. Conf. on Controlling Pollution from Coal, Taiwan, R.O.C., May 12-13, 1988.

J.T. Riley, "Modern Methods of Chemical Analysis," Fujian Province Conf. on Anal. Chem., Fuzhou, P.R.O.C., June 3, 1988.

J.T. Riley, F.J. Hayes, and D.L. Withers, "Nonadditive Analytical Values for Coal Blends," 74th Annual KAS Mtg., Richmond, KY, Nov. 4-5, 1988.

J.T. Riley, W.G. Lloyd, M.A. Risen, S.R. Gilleland, and R.L. Tibbitts, "Predicting Ash Fusion Temperatures from Elemental Analysis," 7th Internat. Coal Testing Conf., Charleston, WV, Mar. 21-23, 1989.

J.T. Riley, S.R. Gilleland, R.F. Forsythe, H.D. Graham, Jr., and F.J. Hayes, "Nonadditive Analytical Values for Coal Blends," 7th Internat. Coal Testing Conf., Charleston, WV, Mar. 21-23, 1989.

J.R. Smith, J.E. Winstead and J.T. Riley, "Sulfur Extraction from Wood Tissue of Short-leaf Pine in Relation to Age and Specific Gravity," 19th Annual Sigma Xi Research Conf., WKU, Mar. 23-24, 1989.

R.F. Forsythe, H.D. Graham, Jr., S.R. Gilleland, F.J. Hayes, and J.T. Riley, "Nonadditive Analytical Values for Coal Blends," 19th Annual Sigma Xi Research Conf., WKU, Mar. 23-24, 1989.

R.L. Tibbitts, M.A. Risen, S.R. Gilleland, and J.T. Riley, "Distribution of Sulfur in Ashes from Coal Blends," 19th Annual Sigma Xi Research Conf., WKU, Mar. 23-24, 1989.

M.A. Risen, J.T. Riley, W.G. Lloyd, R.L. Tibbitts, and S.R. Gillelend, "Prediction of Reducing Atmosphere Ash Fusion Temperatures from Elemental Analysis," 19th Annual Sigma Xi Research Conf., WKU, Mar. 23-24, 1989.

S.R. Gilleland, J.T. Riley, W.G. Lloyd, S. Zhou, and R.L. Tibbitts "Modeling Ash Fusion Characteristics from Elemental Analysis," 19th Annual Sigma Xi Research Conf., WKU, Mar. 23-24, 1989.

J.T. Riley, G.M. Ruba, and C.C. Lee, "Direct Determination of Organic Sulfur in Coal," National ACS Mtg., Dallas, TX, April 9-14, 1989.

W.G. Lloyd, J.T. Riley, S.R. Gilleland, M.A. Risen, and R.L. Tibbitts, "Estimation of Ash Fusion Temperatures from Elemental Compositional Data," 75th Annual KAS Mtg., Lexington, KY, Nov. 16-18, 1989.

S.R. Gilleland, J.T. Riley, S. Zhou, and R.L. Tibbitts, "Modeling Ash Fusion Characteristics from Elemental Analysis," 75th Annual KAS Mtg., Lexington, KY, Nov. 16-18, 1989.

R.L. Tibbitts, J.T. Riley, M.A. Risen, and S.R. Gilleland, "Distribution of Sulfur in Ashes from Coal Blends," 75th Annual KAS Mtg., Lexington, KY, Nov. 16-18, 1989.

J.T. Riley, M. Zhu, R.F. Forsythe, H.D. Graham, Jr., and S.R. Gilleland, "Distribution of Organic Sulfur in Raw and DMF-Extracted Coals," 75th Annual KAS Mtg., Lexington, KY, Nov. 16-18, 1989.

S.R. Gilleland, J.L. Werth, and J.T. Riley, "Inductively Coupled Plasma-Atomic Emission Spectroscopic Analysis of Solids-Water Slurries," 20th Annual Sigma Xi Research Conf., WKU, Mar. 22-23, 1990.

R.L. Tibbitts, H.D. Graham, Jr., and J.T. Riley, "X-Ray Fluorescence Spectroscopic Analysis of Whole Coal," 20th Annual Sigma Xi Research Conf., WKU, Mar. 22-23, 1990.

M. Zhu, H.D. Graham, Jr., S.R. Gilleland, R.L. Tibbitts, and J.T. Riley, "Enrichment of Organic Sulfur in Extracts of Bituminous Coals," 20th Annual Sigma Xi Research Conf., WKU, Mar. 22-23, 1990.

J.T. Riley, M. Zhu, H.D. Graham, Jr., S.L. Wilson, R.L. Tibbitts, and D.S. Coffey, "Removal of Aliphatic Sulfur and Chlorine from Coal," Eighth Annual CRSC Contractor's Meeting, Urbana, IL, July 31 - Aug. 2, 1990.

S.R. Gilleland, J.L. Werth and J.T. Riley, "Coal Slurry Analysis by Inductively Coupled Plasma Spectroscopy," 8th Internat. Coal Testing Conf., Lexington, KY, Sept. 18-20, 1990.

J.T. Riley, "University Coal Chemistry Programs," 8th Internat. Coal Testing Conf., Lexington, KY, Sept. 18-20, 1990.

S.R. Gilleland, J.L. Werth, M.J. Mertens, L.M. Lewis, and J.T. Riley, "Inductively Coupled Plasma Spectrometric Analysis of Coal-Water Slurries," 76th Annual KAS Mtg., Covington, KY, Nov. 9-10, 1990.

H.D. Graham, Jr., R.L. Tibbitts, and J.T. Riley, "X-Ray Fluorescence Spectrometric Analysis of Raw Coal," 76th Annual KAS Mtg., Covington, KY, Nov. 9-10, 1990.

J.T. Riley, M. Zhu, D.S. Coffey, H.D. Graham, Jr., and L.M. Lewis, "Removal of Aliphatic Sulfur Compounds from Coal," 76th Annual KAS Mtg., Covington, KY, Nov. 9-10, 1990.

J.T. Riley, W.G. Lloyd, F.J. Hayes, G.M. Ruba, S.R. Gilleland, and M. Zhu., "Ultrafine Grinding to Enhance the Reactivity of Coal," Engineering Found. Fine Coal Cleaning Conf., Palm Coast FL, Dec. 3-7, 1990.

J.T. Riley, M. Zhu, D.S. Coffey, S.G. Sadler, and J.M Stidam, "Distribution of Organic Sulfur in Raw and Solvent-Extracted Coals, 201st National ACS Meeting, Atlanta, GA, Apr. 14-19, 1991.

W.G. Lloyd, J.T. Riley, M.A. Risen, S.R. Gilleland, and R.L. Tibbitts, "Estimation of Ash Fusion Temperatures from Elemental Composition: A Strategy for Regressor Selection," 201st National ACS Meeting, Atlanta, GA, Apr. 14-19, 1991.

J.T. Riley, J.L. Werth, L.M. Lewis, and M.J. Mertens, "ICP Analysis of Coal Slurries," 2nd Internat. Conf. on Element. Anal. of Coal and its By-Products, Barren River Resort, Sept. 9-11, 1991

J.T. Riley, J.L. Werth, L.M. Lewis, and M.J. Mertens "The Effect of Slurried Coal Particle Size on ICP Emission Intensities," 77th Annual KAS Meeting, Owensboro, KY, Nov. 7-9,

H.D. Graham, Jr, D.S. Coffey, B. Wang, M. Zhu, and J.T. Riley, "Removal of Chlorine from Illinois Basin Coals Using Mild Oxidative Conditions," 21st Annual Sigma Xi Research Conf., WKU, Apr. 1-2, 1991.

D.S. Coffey, S.G. Sadler, J.M. Stidam, and J.T. Riley, "Distribution of Organic Sulfur in Raw and THF-Extracted Coals," 21st Annual Sigma Xi Research Conf., WKU, Apr. 1-2, 1991.

J.L. Werth, M.J. Mertens, L.M. Lewis, S.R. Gilleland, and J.T. Riley, "The Effect of Coal Rank on the Inductively Coupled Plasma Spectrometric Analysis of Coal-Water Slurries," 21st Annual Sigma Xi Research Conf., WKU, Apr. 1-2, 1991.

M.J. Mertens, L.M. Lewis, J.L. Werth, and J.T. Riley, "The Effect of Slurry Particle Size on the Emission Intensities of Elements in the ICP Analysis of Coal Slurries," 21st Annual Sigma Xi Research Conf., WKU, Apr. 1-2, 1991.

T. Roth, M. Campbell, M. Zhang, J.T. Riley, and W.P. Pan, "Evaluation of Combination Fuels for Fluidized Bed Combustors by Thermal Analytical Techniques," 21st Annual Sigma Xi Research Conf., WKU, Apr. 1-2, 1991.

B. Wang, M. Zhu, D.S. Coffey, H.D. Graham, Jr., S.G. Sadler, J.L. Werth, M.J. Mertens, L.M. Lewis, M.A. Hite, J.M. Stidam, and J.T. Riley, "Mild Oxidative Desulfurization of Coal," 21st Annual Sigma Xi Research Conf., WKU, Apr. 1-2, 1991.

E.J. Hutchinson, J.W. Smith, J.T. Riley, and W.P. Pan, "Design of a Fluidized Bed Combustor," 21st Annual Sigma Xi Research Conf., WKU, Apr. 1-2, 1991.

M. Campbell, M. Zhang, J.T. Riley, and W.P. Pan, "Evaluation of Combination Fuels for Fluidized Bed Combustors by Thermal Analytical Techniques," 201st National ACS Meeting, Atlanta, GA, Apr. 14-19, 1991.

D.S. Coffey, S.G. Sadler, J.M. Stidam, and J.T. Riley, "Organic Sulfur in Raw and Extracted Coals," 77th Ann. KAS Meeting, Owensboro, KY, Nov. 7-9, 1991.

B. Wang, H.D. Graham, Jr., L.M. Lewis, and J.T. Riley, "Desulfurization of Coal Using Mild Oxidative Conditions," 77th Ann. KAS Meeting, Owensboro, KY, Nov. 7-9, 1991.

E.J. Hutchinson, J.W. Smith, J.T. Riley, and W.P. Pan, "Design of a Fluidized Bed Combustor," 77th Ann. KAS Meeting, Owensboro, KY, Nov. 7-9, 1991.

S. Burris and J.T. Riley, "Magnetic Resonance Measurements of Moisture in Coal," 22nd Annual Sigma Xi Research Conf., WKU, April 9-10, 1992.

H.D. Graham, Jr., S. Thomas, L.M. Lewis, B. Wang, M.J. Mertens, S. Burris, and J.T. Riley, "Fungal Desulfurization of Coal," 22nd Annual Sigma Xi Research Conf., WKU, April 9-10, 1992.

J.M. Stidam, T. Selby, J.L. Werth, C.E. Anderson, and J.T. Riley, "Use of Acid-Insoluble Ash as a Marker in Nutrient Digestibility Studies," 22nd Annual Sigma Xi Research Conf., WKU, April 9-10, 1992.

J.L. Werth, L.M. Lewis, T. Selby, T. Woods, C.E. Anderson, and J.T. Riley, "ICP and XRF Mineral Assays in Animal Digestibility Studies," 22nd Annual Sigma Xi Research Conf., WKU, April 9-10, 1992.

B. Wang, W.P. Pan, and J.T. Riley, "Determination of Coal Sulfur Forms Using Thermal Analytical Techniques," 22nd Annual Sigma Xi Research Conf., WKU, April 9-10, 1992.

E.J. Hutchinson, J.W. Smith, J.T. Riley, and W.P. Pan, "Design of a Fluidized Bed Combustor System," 22nd Annual Sigma Xi Research Conf., WKU, April 9-10, 1992.

T. Roth, M. Campbell, M. Zhang, W.P. Pan, and J.T. Riley, "Evaluation of Combination Fuels for Fluidized Bed Combustors Using Thermal Analytical Techniques," 22nd Annual Sigma Xi Research Conf., WKU, April 9-10, 1992.

J.T. Riley, T. Roth, M. Zhang, and W.P. Pan, "Thermogravimetric-Fourier Transform Infrared Analysis (TG/FTIR) Studies of Combination Fuels," 9th International Coal Testing Conf., Lexington, KY, Mar. 17-19, 1992.

J.T. Riley, D. Shao, W.P. Pan, and C.L. Chou, "Behavior of Chlorine in Coal During Pyrolysis and Combustion," 9th International Coal Testing Conf., Lexington, KY, Mar. 17-19, 1992.

Appendix B

Publications by J.T. Riley and Students During the 1988-92 Period.

K.W. Kuehn, W.G. Lloyd, J.T. Riley, and D.W. Kuehn, "Preparation and Characterization of Slurried Micronized Coals: I. Investigation of Coal Composition -- Particle Size Relations," J. Organic Geochem., 1988, 12(4), 413-417.

K.W. Kuehn, W.G. Lloyd, J.T. Riley, and D.W. Kuehn, "Ultrafine Milling of Selected Western Kentucky Coals," J. Coal Quality, 1988, 7(2), 61-64.

W.G. Lloyd, J.T. Riley, K.W. Kuehn, and D.W. Kuehn, "Chemistry and Reactivity of Micronized Coals," Final Tech. Rept., U.S. Department of Energy Contract No. DOE/PC/80514, February 15, 1988.

J.T. Riley "Coal and Sulfur Forms Analysis and Desulfurization," Proceedings, Internat. Conf. on Controlling Environmental Pollution from Coal and Chem. Anal., Chung-Li, Taiwan, R.O.C., 1988, 29-61.

J.T. Riley, W.G. Lloyd, M.A. Risen, R.L. Tibbitts, and S.R. Gilleland, "Prediction of Ash Fusion Temperatures," Proceedings, Seventh Internat. Coal Testing Conf., Charleston, WV, 1989, 58-63.

J.T. Riley, S.R. Gilleland, R.F. Forsythe, and H.D. Graham, Jr., "Nonadditive Analytical Values for Coal Blends," Proceedings, Seventh Internat. Coal Testing Conf., Charleston, WV, 1989, 32-38.

J.T. Riley and G.M. Ruba, "Comparison of Sulphur in HNO_3-Extracted and Physically Cleaned Coals," Fuel, 1989, 68, 1594-1597.

J.T. Riley, G.M. Ruba, and C.C. Lee, "Direct Determination of the Total Organic Sulfur in Coal," Chap. 13 in Geochemistry of Sulfur in Fossil Fuels, W.L. Orr and C.M. White, Eds., No. 429, ACS Symposium Series, American Chemical Society, Washington, DC, 1990.

J.T. Riley, M. Zhu, S.R. Gilleland, H.D. Graham, Jr., S.L. Wilson, R.L. Tibbitts, and D.S. Coffey, "Removal of Aliphatic Sulfur and Chlorine Compounds from Coal," Tech. Rpt. No. 1, The Center for Research on Sulfur in Coal, Contract No. SIU-C-#89-13, May, 1990.

J.T. Riley, M. Zhu, D.S. Coffey, H.D. Graham, Jr., J.P. Riley, and L.M. Lewis, "Removal of Aliphatic Sulfur and Chlorine Compounds from Coal," Tech. Rpt. No. 2, The Center for Research on Sulfur in Coal, Contract No. SIU-C-#89-13, August, 1990.

J.T. Riley, B. Wang, D.S. Coffey, H.D. Graham, Jr., S.G. Sadler, J.L. Werth, M.J. Mertens and L.M. Lewis, "Removal of Aliphatic Sulfur and Chlorine Compounds from Coal," Tech. Rpt. No. 3, The Center for Research on Sulfur in Coal, Contract No. SIU-C-#89-13, December, 1990.

J.T. Riley, W.G. Lloyd, K.W. Kuehn, D.W. Kuehn, and D.L. Withers, "Coal Density Changes During Stirred-Ball Attritor Milling," J. Coal Quality, 1990, 9(1), 12-17.

W.G. Lloyd, J.T. Riley, S.R. Gilleland, R.L. Tibbitts, and M.A. Risen, "Estimation of Ash Softening Temperatures Using Crossterms and Partial Factor Analysis," Energy and Fuels, 1990, 4, 360-364.

J.T. Riley, S.R. Gilleland, and J.L. Werth, "Coal Slurry Analysis by Inductively Coupled Plasma Spectroscopy," Proceedings, Eighth Internat. Coal Testing Conf., Lexington, KY, 1990, 46-51.

J.T. Riley, "University Coal Chemistry Programs," Proceedings, Eighth Internat. Coal Testing Conf., Lexington, KY, 1990, 87-90.

J.T. Riley, M. Zhu, B. Wang, D.S. Coffey, H.D. Graham, Jr., L.M. Lewis, J.P. Riley, S.G. Sadler, J.L. Werth, M.J. Mertens, S.L. Wilson, R.L. Tibbitts, S.R. Gilleland, and M.A. Hite, "Removal of Aliphatic Sulfur and Chlorine Compounds from Coal," Final Tech. Rpt., The Center for Research on Sulfur in Coal, Contract No. SIU-C-#89-13, February, 1991.

J.T. Riley, M. Zhu, D.S. Coffey, S.G. Sadler, J.M. Stidam, and H.D. Graham, Jr., "Distribution of Organic Sulfur in Raw and Solvent Extracted Coals," Amer. Chem. Soc., Div. Fuel Chem., 1991, 36(2), 820-29.

W.G. Lloyd, J.T. Riley, M.A. Risen, S.R. Gilleland, and R.L. Tibbitts, "Estimation of Ash Fusion Temperatures from Elemental Composition: A Strategy for Regressor Selection," Amer. Chem. Soc., Div. Fuel Chem., 1991, 36(1), 235-249.

W.P. Pan, M. Campbell, J.T. Riley, and M. Zhang, "Evaluation of Combination Fuels for Fluidized Bed Combustors by Thermal Analytical Techniques," Amer. Chem. Soc., Div. Fuel Chem., 1991, 36(2), 830-837.

J.T. Riley, W.G. Lloyd, K.W. Kuehn, D.W. Kuehn, F.J. Hayes, D.L. Withers, G.M. Ruba, S.R. Gilleland, and M. Zhu, "Ultrafine Grinding to Enhance the Reactivity of Coal," Coal Preparation, 1992, 10, 145-158.

J.T. Riley, J.L. Werth, L.M. Lewis, and M.J. Mertens, "ICP Analysis of Coal Slurries," in Elemental Analysis of Coal and Its By-Products, G. Vourvopoulos, Ed., World Scientific Publishing Co., River Edge, NJ, 1992, pp. 124-144.

T. Roth, M. Zhang, J.T. Riley, and W.P. Pan, "Thermogravimetric-Fourier Transform Infrared Analysis (TG/FTIR) Studies of Combination Fuels," Proceedings, 9th International Coal Testing Conf., Lexington, KY, 1992 (in press).

D. Shao, W.P. Pan, J.T. Riley, and C.L. Chou, "Behavior of Chlorine in Coal During Pyrolysis and Combustion," Proceedings, 9th International Coal Testing Conf., Lexington, KY, 1992 (in press).

J.C. Hower, J.T. Riley, G.A. Thomas, and T.B. Griswold, "Chlorine in Kentucky Coals," J. Coal Quality (in press).